working out the explanation inductively. In the autumn of 1847 I was spending an evening with Dr. P. M. Roget, at his house in Woburn Square, when among other subjects we conversed upon was that of optical illusions. The inverted pin was one of his illustrations, and I think he mentioned having explained it in some scientific serial.

Some years ago the late Mr. Becker, formerly scientific foreman to Messrs. Elliot Brothers, constructed for me a binocular apparatus for showing the union of two shadows, one on each retina. To my surprise I found the resulting phantom did not differ in position from the single shadow. C. M. INGLEBY

Athenæum Club

How to Prevent Drowning

I ONLY write in the interests of humanity. Let those who will go in for swimming, and I wish sincerely that every one could swim. Treading water however conducts at once to swimming. Every one can tread water who likes. It is just as easy, if we only knew it, to tread water as to tread the earth, and proximately just as safe. Men and women might walk into the deep sea and out again when they pleased. Nature has not been so niggard with us as some persons imagine. Why are we not as safe in water as is the dog? It is simply because he treads water, and we do not. As often as I chose to chuck my stick into the Causey surge my dog brought it out. I could have done the same; any one could do the same who chose. But assuredly I should have paddled water as the dog did. In treading water the body is erect, or nearly so; in swimming we sprawl, and are comparatively helpless. The admirals, both of them, have given valuable testimony as regards the efficacy of treading water. Before the present pier at the Cape was built, vessels in bad weather could not communicate with the shore, even by boats. Men, then, treading water amid the mountain seas, carried communications to and fro in oilskin caps. I have heard it was the same at Madras. Young Gordon, apprentice to the sea, fell into mid-ocean while fisting a sail. The poor fellow's heart sank when he saw the ship sailing away. But, as he afterwards told me, he trod water, and kept up till the boat reached him. I have trodden water again and again with a big boy on my back. Any one might do the same. Not one woman in ten thousand, not one man in a thousand, I suppose, can swim. They do not know they can tread water when they fall in, and of course drown, as two fine young women who had got a little out of their depth in this place did last year. But ignorance and prejudice cannot always rule, and the day will surely come when human beings, better instructed, shall enjoy the same immunity in the water that other animals not human beings, now enjoy. HENRY MACCORMAC

Bournemouth, June

Buoyancy of Bodies in Water

A propos of the question of drowning, as the same is now raised in NATURE, and especially so as to the alleged "fact that men are very different in buoyancy," allow me to say that when stationed many years ago at Pembroke Dock, South Wales, two soldiers were drowned there within a few days of each other. One of these casualties occurred off an island named the Stack Rock, in Milford Haven, that was garrisoned by invalided artillery, while the other took place in the creek that separates the town and dockyard from the huts. In the former instance the body of the (drowned) man remained floating upright in the water, "bobbing up and down with every wave"—as an eyewitness assured me—for a considerable time, or until it was lost to sight or recovered (I forget which just now). In the latter the body—that of a healthy, muscular man—was picked up a day or so afterwards by a passing boat as it was floating out with the tide to sea; and I have since seen several fresh bodies floating in the Ganges. Indeed the survivors always attach weights to the remains of even the poorest of their kindred ere they deposit them in that sacred stream; but this may be for the purpose of counteracting the current; and it is, I think, generally assumed in books and courts of law that all bodies, human and bestial, sink as a rule in water as soon as life is extinct; in other words, it is stated that they remain submerged till decomposition sets in, or sets up such an amount of gas within them as enables them to overcome all resistance from above, and float. If such be the case we must either suppose that the corpses referred to within possessed some special attributes of their own, or that "men are very different in buoyancy" after death than they were during life. Assuredly these men could not have been lost in this way had their bodies been able to float in the one state as well as they were in the other; and I heartily agree with Mr. Hill when he says that "no amount of coolness or presence of mind will either supersede the art of swimming or alter the laws of gravity."

Ashton-under-Lyne W. CURRAN

Resonance of the Mouth-Cavity

THE observation of Mr. John Naylor, forwarded to you by Mr. Sedley Taylor (p. 100), admits of being made with more striking (because louder) results than by the method described, and so far from being a "discovery," is well known to most schoolboys. Tap with the thumb-nail upon the front teeth, and at each tap alter the shape of the mouth-cavity so as to produce the note desired; any tune may then be played loud enough to be heard at the other end of a large room. It is remarkable that without previous practice one instinctively shapes the mouth-cavity so as to produce, in almost every case, the exact note required. GEORGE J. ROMANES

Thunder Storm at the Cape

A YOUNG man of my acquaintance, who some time ago joined the Cape Mounted Rifles, has just forwarded to me an account of a severe storm which occurred on the evening of Thursday last, April 14. C. TOMLINSON

Highgate, N., June 13

"The storm set in about 6 p.m., whilst the men were at stables, and was accompanied by loud thunder and vivid flashes of lightning. At 6.15 there was a fearful roll of thunder, accompanied by a most vivid flash, which lit up the square for at least thirty seconds. It struck the barracks at the upper end, ran past a room to the stables, which have iron roofs; it ran along the course of the roofs into the stables, striking down two men in the doorway. It then ran along the iron of the manger, flooring all the horses, nineteen in all, and so went to ground. One man was struck in the left shoulder bone, the fluid passing from there under the left arm to his watch in the left-hand trousers pocket, and burnt a hole clean through the silver case. From the watch it struck again six inches below, and travelled round the leg under the knee, and from thence probably to the spurs, as no burn was found below the knee. The extremities of both tracks were marked by large burns, and each track by a burn two inches over. The surgeon says it was the most miraculous escape he ever saw, the watch having saved the man's life. The second man was merely stunned, and lost the use of his legs for some hours; he was standing in the stable behind the first, and although only slightly burnt, is still unable to walk. The other is doing well, but is rather dazed. Ten other men were floored, but soon regained their legs. As to the horses, one was struck dead in the forehead: two others, blind in both eyes, were shot yesterday; and four more blind in one eye are condemned. A horse in town was struck, and his fore-leg broken in four places.

"Within a hundred yards of the barracks is a powder magazine full of powder, fitted with conductors which were struck several times. This occasioned great alarm to the inhabitants, as it contains many tons of powder.

"JOHN P. CUNNINGHAM

"King William's Town, South Africa, April 18"

A Six-Fingered Family

IT may interest some of your readers to hear that there is at present living in Brown's Town, Jamaica, a family in whom the possession of six fingers has been hereditary for at least four generations. Unfortunately they consider the sixth finger a deformity, and always amputate it, so that there is very little opportunity of observing it. There is a little girl there however upon whom this operation has not been performed, and I much regret that, as her parents had taken her up into the hills to work in their provision grounds, I could not see her. As I am informed, the sixth finger springs from the little finger knuckle at right angles to the little finger, and when it is free of it, it turns up parallel to the rest, being a little shorter than the little finger, but quite perfect, with nail and two joints. It is bent and extended with the rest on opening or closing the fist.

Another fact, which I daresay however is usual in such cases,

came under my notice at Brown's Town, viz. two perfectly black parents having a family all pure albinos.

Kingston, Jamaica, May 26 THOMAS CAPPER

Singular Behaviour of a Squirrel

A NEIGHBOUR of mine, whose cottage is thickly surrounded with trees, observed a squirrel, during the severe weather of winter, occasionally stealing food from the troughs set out for the poultry. At first it caused great commotion among the birds, but latterly they were less uneasy in its presence. Taking an interest in the wild creature he began to lay out refuse food for it, including bits of ham, which it greedily appropriated. Getting more courageous, it ventured within doors. After a time it got caught in a trap set for rats underneath the bed. Being freed from its irksome position it was thought that the squirrel would venture no more within doors. Neither the incident of the trap nor confinement for some time within a cage availed to restore to it its original shyness. With the coming of summer its visits have been less regular, but occasionally it looks in still. May not a habit like this, affecting only one out of many, be looked upon as corresponding to a "sport" in the vegetable world, and shed some light on the subject of the domestication of animals? The squirrel seems to have been quite a wild one to start with, for there is no one in the district who had been in the habit of keeping one as a pet. J. SHAW

Dumfriesshire

Hot Ice

IN reply to a very interesting letter on this subject recently published in NATURE (vol. xxiii. p. 504) by Dr. Oliver J. Lodge, I wish to express my views of the theoretical and practical possibility of the experiment of Dr. Carnelley. I wish to start from some well-known principles accepted by everybody acquainted with the mechanical theory of heat and its applications. According to these principles the volume "v" (and also the total amount of internal energy) of water can be expressed as a function of its pressure "p" and temperature "t"; $v = f(p, t)$. The form of this function, which we need not discuss here, will change with the state of aggregation, so that we shall have three different equations expressing the volumes of water in the solid, liquid, and gaseous form.

$$\left.\begin{array}{ll} v = f_{\mathrm{i}}\ (p, t) \ \ldots\ \ldots & \text{ice} \\ v = f_{\mathrm{ii}}\ (p, t) \ \ldots\ \ldots & \text{water} \\ v = f_{\mathrm{iii}}(p, t) \ \ldots\ \ldots & \text{vapour} \end{array}\right\} \begin{array}{l} p \text{ and } t \text{ being considered inde-} \\ \text{pendent variables.} \end{array}$$

Geometrically the volumes of ice, water, and vapour will belong to three different surfaces extending between certain limits. Thus the surface $v = f_{\mathrm{i}}(p, t)$, which represents the volumes of ordinary ice, is situated between the limits $q\,p$, $l\,m$, $m\,d$; the surface representing liquid water lies between $m\,n$ and $m\,d$, though it may be extended a little on either side of these limits, if it applies to water heated or cooled over its regular boiling or freezing temperatures, which are situated along the lines $m\,d$ and $m\,n$.[1] The values of p and t, which belong to $m\,d$ and $m\,n$, will satisfy two equations—$\phi(p, t) = 0$ and $\psi(p, t) = 0$. At these points the water will change its form of aggregation and pass over in the state of saturated vapour along the line $m\,n$ [equation $\psi(p, t) = 0$], or into ice along $m\,d$ [equation $\phi(p, t) = 0$] in a continuous and *reversible* way. At any other point, which is not situated on $m\,n$ or $m\,d$, water may also be liable to change of aggregation, but this process will not be *reversible*. The line $m\,n$, where the surface $v = f_{\mathrm{ii}}(p, t)$ breaks up and liquid water changes into vapour, is the *curve of tension of saturated vapour* contained in the renowned table of Regnault. The boiling-points of water under varying pressure are situated on $m\,n$, and may be found by solving the equation $\psi(p, t) = 0$. At the point m ($p = 4{\cdot}6$ mm., $t = -0^{\circ}{\cdot}0078$ C.) the line $m\,n$ terminates, but is continued by $l\,m$ [equation $\chi(p, t) = 0$], along which the vaporisation of ice takes place in a reversible way. According to the table of Regnault there is no sudden rupture at the point m, the pressure of saturated vapour at 0° C. being identically the same, if the vapour is in contact with water or with ice. The differential coefficients $\dfrac{dp}{dt}$ of the functions $\phi(p, t)$, $\psi(p, t)$, and $\chi(p, t)$, or the tangents to the lines $m\,d$, $m\,n$, and $m\,l$ are found by application of Carnot's Theorem to be of the general form $\dfrac{dp}{dt} = \dfrac{A\,r}{[s - s_1][273 + t]}$ [r = latent heat; s and s_1 = the specific volumes of water in two different forms of aggregation].

The point m, where $m\,n$, $m\,d$, and $m\,l$ unite, is of particular interest. J. Thomson called it "the triple point," and Guldberg the "Fällespunkt" of water. Lately (in *Berichte*, 1880) I ventured to call it the "absolute point of sublimation," not because I wished to introduce a new term for a well-known scientific object, but only to point out some important consequences of the phenomenon just then announced by Carnelley, of which Prof. Lothar Meyer of Tübingen had published an interpretation different from mine. This point m, situated $-0^{\circ}{\cdot}0078$ C. below the ordinary freezing-point of water, is really the upper limit of sublimation, because at any higher temperature ice first changes into water before it evaporates. At $-0^{\circ}{\cdot}0078$ C., where the boiling- and melting-point of water coincide, a real sublimation of ice begins, provided that the barometric pressure does not exceed $4{\cdot}6$ mm. (= "the critical pressure" of Carnelley).

Now according to the discovery of Dr. Carnelley, ice at pressures lower than $4{\cdot}6$ mm. would exist by temperatures up to $+178^{\circ}$ C. Thus the surface $v = f_{\mathrm{i}}(p, t)$, which we have hitherto supposed to be inclosed between the limits $q\,p$, $q\,l$, $l\,m$, $m\,d$ would extend far beyond $l\,m$ nearly up to k, but always at pressures smaller than $4{\cdot}6$ mm. Geometrically this new and unforeseen

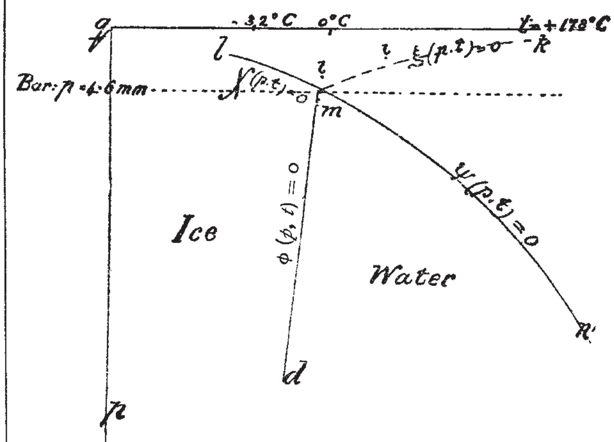

FIG. 1.

extension of the surface of ice is represented by the area $l\,m\,k$. Here the process of Carnelley, whereby ice of low pressure is heated to astoundingly high temperatures, would go on. The area $l\,m\,k$ would of course be entirely a *terra incognita* to the science of the present day, but there is nevertheless no theoretical objection why the surface of ice $v = f_{\mathrm{i}}(p, t)$ should not extend farther than to the limiting line $l\,m$ pointed out by Regnault. Confiding in the experimental proofs already furnished by Dr. Carnelley, I concluded (*Berichte*, 1880): if the surface of ice really extends upwards to about $+178^{\circ}$ C. there must be a limiting line $m\,k$ to the area $l\,m\,k$, since this area cannot extend so far as to the dotted line in the figure indicating the critical pressure $= 4{\cdot}6$ mm. At this new limit, $m\,k$, corresponding to an equation $\xi(p, t) = 0$, the vaporisation of the "hot ice" may go on in a reversible way, just as liquid water gives up saturated vapour at those pressures and temperatures which belong to the line $m\,n$ (equation $\psi(t, p) = 0$). The line $m\,k$ would in many respects be the continuation of $m\,d$ (just as $m\,l$ forms the continuation of $m\,n$), but naturally the symbols entering the equation of its differential coefficient $\dfrac{dp}{dt} = \dfrac{A\,r}{(s - s_1)(273 + t)}$ must change their signification on the other side of the point m, so that r here would represent the latent heat of *vaporisation* of the hot ice, s its specific volume, &c. I did not expressly mention this in my paper in the *Berichte*, because I thought it unnecessary. This omission on my side may probably have misled Dr. O. Lodge as to the real meaning of my words, since he declares my opinion that an equation $\xi(p, t) = 0$ having a differential

[1] The surface corresponding to the volumes of aqueous vapour $v = f_{\mathrm{iii}}(p, t)$ is not sketched in the figure, which gives only *the projection* of the surfaces on the plane of co-ordinates p and t, not the real situation of these surfaces in space. The reader will also observe that the limiting lines $m\,n$, $n\,d$, $l\,m$, $m\,k$ are the *intersections* of vertical cylindrical surfaces ("Uebergangsflächen") with the plane p, t.